

LUNAR SAMPLE ALLOCATION GUIDEBOOK

Astromaterials Acquisition and Curation Office
Astromaterials Research and Exploration Science Directorate

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National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

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1.0 INTRODUCTION

1.1 Purpose

The Lunar Sample Allocation Guidebook is a reference source for lunar sample investigators and prospective investigators, and includes descriptions of specific procedures and requirements, as well as Lunar Curatorial and other facilities available to support lunar sample investigators.

1.2 Overview of the Apollo Lunar Sample Collection

The Apollo missions to the Moon included six piloted landings in 1969-72 that returned to Earth a total of 382 kilograms (842 pounds) of geologic samples consisting of 2,196 separate specimens. Table 1 summarizes the original collection on a mission-by-mission basis. Recognizing that the scientific value of the samples can be maximized only by intensive study of the materials, NASA continuously has made available subsamples of lunar material to qualified investigators. Results of those studies have been published by teams of investigators, as well as by individual investigators, in the open scientific literature. An authoritative digest of those findings can be found in *Lunar Sourcebook: A User's Guide to the Moon* (G. Heiken, D. Vaniman, and B. M. French, Eds.; Cambridge University Press, 736 pp.; 1991; ISBN 0-521-33444-6) and the *New Views of the Moon* (B. Jolliff, M. Wieczorek, C. Shearer, and C. Neal, Eds.; Mineralogical Society of America Reviews in Mineralogy & Geochemistry, Vol. 60, 772 pp.; 2006; ISBN 0-939-95072-3). Although samples have been provided to thousands of different research projects, conservation of the sample collection has assured that substantial amounts of pristine sample material remain available for continuing and future studies.

Table 1. Summary of Apollo lunar sample collection returned from the Moon.

		Rocks		Core samples		Regolith Fines		Mission Total	
Mission	No	Mass(g)	No	Mass(g)	No	Mass(g)	No	Mass(g)	
AP 11	50	9685.717	2	98.2	16	11770.625	68	21554.542	
AP 12	49	27682.04	4	427.1	16	6242.4	69	34351.54	
AP 14	151	28629.81	6	377.59	70	13277.31	227	42284.71	
AP15	267	58578.16	11	4645.0	179	140887.4	457	77310.56	
AP16	544	70069.321	16	7050.7	282	18594.43	842	95714.451	
AP17	335	73712.513	17	7337.28	398	29468.421	750	110518.214	
TOT.	11396	268357.561	56	19935.87	961	93440.586	2413	381734.017	

2.0 ACCESS TO LUNAR SAMPLES

NASA policies define lunar samples as a limited national resource and future heritage, and require that samples be released only for approved applications in research, education, and public display. To meet that responsibility, NASA carefully screens all sample requests with most of the review process delegated to the Curation Analysis and Planning Team for Extraterrestrial Materials (CAPTEM) and the Lunar Sample Curator. All individuals requesting a lunar sample should follow the steps given below for the appropriate category of sample.

2.1 Research samples

NASA provides lunar rock, regolith, and core samples for both destructive and non-destructive analysis in pursuit of new scientific knowledge. Requests are considered for both basic studies in planetary science and applied studies in lunar materials beneficiation, resource utilization, and human spaceflight.

2.1.1 The sample investigator must demonstrate favorable scientific peer review of the proposed work involving lunar samples.

The required peer review can be demonstrated in any one of three ways: (1) a formal research proposal recommended by any NASA funding program for planetary or program science within the past three years; (2) a formal research proposal recommended and funded by any government or non profit funding agency, foreign or domestic; or (3) submittal of a proposal for the research supported by reprints of scientific articles pertaining directly to the specific research methods to be applied to the samples (step 2.1.2), and published in peer-reviewed professional journals.

New investigators not familiar with lunar materials should consult *Lunar Sourcebook: A User's Guide to the Moon* (G. Heiken, D. Vaniman, and B. M. French, Eds.; Cambridge University Press, 736 pp.; 1991) and the *New Views of the Moon* (B. Jolliff, M. Wieczorek, C. Shearer, and C. Neal, Eds.; Mineralogical Society of America Reviews in Mineralogy & Geochemistry, Vol. 60, 772 pp.; 2006). See also www.lpi.usra.edu.

2.1.2 The investigator submits a written request specifying the numbers, types and quantities of lunar samples needed as well as the planned use of the samples.

For planetary science studies, the sample request proposal should be submitted directly to the Lunar Sample Curator at the follow address:

Gary E. Lofgren
Lunar Sample Curator
Mail Code KT
NASA Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696
USA
Office: 281-483-6187
Fax: 281-483-5347
E-Mail: gary.e.lofgren@nasa.gov

The sample request must present the scientific or technological justification, the scientific or technological methods, and the scientific or technological benefits. The request will be considered favorably if preliminary work has been completed on terrestrial, meteoritic, or lunar simulant materials using proposed peer-reviewed methods. Requests determined to be sufficiently mature to warrant consideration for use of lunar materials will be forwarded to CAPTEM by the Lunar Sample Curator.

For new investigators, tangible evidence of favorable peer review (step 2.1.1) should be attached to the sample request proposal together with appropriate résumés. Investigators proposing the application of new analytical methodologies (not previously applied to lunar

samples) should submit test data obtained for simulated lunar materials including meteoritic and carefully selected terrestrial materials.

The Curation Web site contains a summary of the requirements for lunar sample requests:

<http://curator.jsc.nasa.gov/>

2.1.3 The Lunar Sample Curator will research the availability of the requested samples and decide whether the request can be processed without further action or if the request is to be reviewed by CAPTEM.

Outside review is prescribed for all new investigators and for most established investigators except where returned (previously used) samples are being requested. For outside review, the Lunar Sample Curator forwards the original request, with background information, to CAPTEM, a standing committee of scientists (with rotating membership) who advise NASA on the care and use of lunar samples. CAPTEM checks for favorable peer review (step 2.1.1) and appropriate sample selection (step 2.1.2).

2.1.4 Given CAPTEM endorsement and concurrence by NASA Headquarters, the Lunar Sample Curator will prepare a Lunar Sample Loan Agreement for signature by the investigator's institution.

The agreement delineates the responsibilities of the new investigator and requires a security plan that prescribes precautions to minimize prospects for theft or unauthorized use of lunar samples. A PI's privilege for retention and use of lunar samples is contingent upon continued compliance with the Lunar Sample Loan Agreement. The PI will remain in good standing by fulfilling the following obligations: (1) maintenance of, and adherence to, the lunar sample loan agreement and security plan; (2) timely cooperation with annual lunar sample inventory; and (3) timely cooperation with sample recalls.

2.1.5 Upon receipt of the properly executed loan agreement, the Lunar Sample Curator prepares the authorized samples and sends them to the investigator.

Quantities less than 10 grams can be sent directly by U. S. registered mail to domestic investigators. Shipments to foreign investigators are sent by an international courier service, e.g. FedEx. *Quantities larger than 10 grams will usually be hand-carried by the investigator or a designated representative; exceptions to this requirement will be considered by the Lunar Sample Curator.*

2.1.6 Continuation as a Lunar Sample PI.

A PI's privilege for retention and use of lunar samples is contingent upon continued good standing in the Lunar Sample Program. The PI will remain in good standing by fulfilling the following obligations: (1) maintenance of, and adherence to, the lunar sample loan agreement and security plan; (2) timely cooperation with annual lunar sample inventory; and (3) timely cooperation with sample recalls.

2.2 Public Display Samples

NASA provides for a limited number of rock samples to be used for either short-term or long-term displays at museums, planetariums, expositions, or professional events that are open to the public. Requests for such display samples are administratively handled by the JSC Public

Affairs Office (PAO). Requestors located in the United States should apply in writing to the following address:

Mr. Louis Parker
Exhibits Manager
Mail Code AP161
Office of Public Affairs
NASA Johnson Space Center
2101 NASA Parkway
Houston, TX 77058-3696
USA
Email: louis.a.parker@nasa.gov
Office: 281-483-8622
Fax: 281-483-4876

For both domestic and foreign requestors, Mr. Parker will pass along the request to CAPTEM, via the Lunar Sample Curator, for advice on available samples and the suitability of the request. He will then advise successful applicants regarding provisions for receipt, display, and return of the samples. All loans will be preceded by a signed loan agreement executed between NASA and the requestor's organization. Mr. Parker will coordinate the preparation of new display samples with the Lunar Sample Curator.

The Curation Web site contains a summary of the requirements for lunar sample display requests:

<http://curator.jsc.nasa.gov/>

2.3 Educational Thin Sections Packages

NASA prepared polished thin sections of representative lunar rocks on rectangular 1 x 2-inch glass slides, with special safety frames, that are suitable for use in college and university courses in petrology and microscopic petrography for advanced geology students. Each set of 12 slides is accompanied by a sample disk of representative lunar rocks and soils, embedded in rugged acrylic disks suitable for classroom use and teaching materials. The typical loan period is two weeks. The Thin Section Package is sent 10 days in advance by registered mail. Each requestor must apply in writing, on college or university letterhead, to the following address:

Mary Drake
Education Sample Curator
Mail Code KT
NASA/Johnson Space Center
2101 NASA Parkway
Houston, TX 77058-3696
Email: mary.k.drake@nasa.gov
USA
Office: 281-483-3154
Fax: 281-483-5347

For each approved user, the Curation Office will prepare a loan agreement to be executed between NASA and the requestor's institution prior to shipment of the thin section package.

3.0 LUNAR SAMPLE ACCOUNTABILITY AND SECURITY

Lunar samples are the property of the United States Government, and it is NASA's policy that lunar sample materials will be used only for authorized purposes. It is therefore essential that rigorous accountability and security procedures be followed by all persons who have access to lunar materials. The elements of these procedures, described in the next sections, are (1) lunar sample loan agreement, (2) lunar sample security agreement, (3) PI accounting procedures for lunar samples, and (4) annual lunar sample inventory.

A program is in place for spot checks, by the Lunar sample curator, the JSC Security Division, and the International Relations Division of NASA Headquarters, for investigator adherence to procedures described in this guidebook, adherence to the provisions of security plans, and adherence to the requirement for annual sample inventories.

3.1 Lunar Sample Loan Agreements

A current loan agreement is a condition for the receipt and use of lunar research samples and lunar educational samples. These legally binding agreements specify the conditions for the loan of lunar samples, including security measures for safeguarding the samples, the return of loaned samples to NASA and, for research samples, an annual inventory of samples in the PI's possession. Appendix A1, *Domestic Lunar Sample Loan Agreement* and Appendix A2, *International Lunar Sample Loan Agreement* are examples of a loan agreement for research on lunar samples. Appendix B, *Lunar Petrographic Thin Section Package Loan Agreement*, is an example of a loan agreement for educational samples. Typically, research samples are loaned for a period of one, two, or three years. Educational samples are loaned for a standard period of two weeks, unless other time periods are justified by the requestor and approved by the Lunar Sample Curator who may seek guidance from CAPTEM in this decision.

3.2 Lunar Sample Security

A lunar sample PI is responsible for the control and safeguarding of all lunar samples consigned to his/her custody. In the event a sample is missing, lost, or cannot be accounted for, the PI must immediately report it to the local law enforcement agency and to the Lunar Sample Curator. A delay in reporting could seriously impede efforts to locate and recover the sample.

To ensure that appropriate procedures and safeguards are carried out in the PI's laboratory, and at the laboratories of his/her co-investigators if different from his/her own, a sample security plan is required. For research samples, the security plan is an attachment to the loan agreement as shown in Appendix A1, *Lunar Sample Loan Agreement* or A2, *International Lunar Sample Loan Agreement*. For educational samples, the security plan is incorporated in the loan agreement as shown in Appendix B, *Lunar Petrographic Thin Section Package Loan Agreement*.

It is recognized that security plans may differ somewhat between investigators, but every plan must incorporate the elements of security outlined in the *Lunar Sample Loan Agreement*. Changes in security plans are considered to be changes in scope of a contractual agreement, and must be submitted in writing to the Lunar Sample Curator for approval. The elements of an appropriate security plan include maintenance of an inventory log, keeping lunar samples under continual supervision, keeping lunar samples under the control of the PI and/or his designate. In

no case may the lunar samples be stored with money, precious stones or minerals, classified material, or any other item that is considered to be of high theft value.

3.3 Lunar Sample Accountability

Lunar sample investigators are expected to maintain complete records of the use of lunar samples in their possession. The samples become the PI's responsibility when delivery of the samples from NASA has been accepted, and that responsibility ends only when (1) the samples have been returned to NASA in the manner authorized, and (2) all sample material has been accounted for. The following sections specify requirements of sample accountability which must be met by a lunar sample PI.

3.3.1 Sample Transfer Documentation for Research and Educational Samples

All sample transfers between the Lunar Sample Curator and PIs must be documented. By signing the Sample Assignment Form (Appendix C), the recipient investigator becomes accountable for the sample. A PI may delegate authority to another person to receive samples in his/her name. Such a delegation of authority must be in writing and a copy must be on file with the Lunar Curator. A delegation of authority does not relieve the PI of responsibility for samples received by the delegated alternate or Co-Investigator.

Research samples transmitted by the Lunar Curator are accompanied by a *Lunar Sample Assignment* form, an example of which is shown as Appendix C. Educational samples transmitted by the Lunar Curator are accompanied by a *Lunar Petrographic Thin Section Package Sample Assignment* form, an example of which is shown as Appendix D. Upon receipt of samples, the appropriate form must be signed by the PI and returned to the Lunar Sample Curator.

Sample transfers are generally not permitted between or among PIs. The permanent transfer of samples to another PI should be completed by returning the samples to JSC. Samples will be reissued to the new PI. If a portion of an allocated sample is to be transferred to a new PI the sample is to be returned to JSC with an F-75 (Appendix G) documenting the splitting of the original sample. The returned sample will be given a new number and allocated to the new PI. In rare instances it is prudent to make a direct PI to PI transfer. This should only be done with the approval of the Lunar Curator and an F-75 documenting the splitting of the original sample should be sent to the Lunar Curator.

3.3.2 Sample Return Documentation for Research and Educational Samples

All lunar samples and residues remaining at the completion of experiments or investigations are to be returned to the Lunar Sample Curator. Upon the receipt of the samples and sample accountability and history documentation (section 3.3.3) from an investigator, the database will be updated and the Lunar Curator will issue a *Lunar Sample Return Receipt* (Appendix E) for research samples, and a *Lunar Petrographic Thin Section Package Sample Receipt* (Appendix F) for educational samples.

3.3.3 Sample Accountability and History Documentation for Research Samples

A summary of sample accountability information and a brief history of sample treatment must be returned to the Lunar Curator whenever sample materials are returned. *Lunar Curatorial Form F-75, Return Sample Accountability & History* (Appendix G), has been designed to simplify the accounting for allocated sample mass and the handling history of the lunar material while in the investigator's possession.

The sample history should be presented on *Lunar Curatorial Form F-75* as brief narrative describing actions that could have degraded the sample (e.g., processed in air, washed in acetone, crushed, sieved, etc.). Accurate documentation permits reallocation of samples not compromised by tests and handling, to other investigators for research.

Instructions for completing *Lunar Curatorial Form F-75* and for the packaging and mailing of samples to the Lunar Sample Curator will be provided to every investigator. An example of these instructions is shown as Appendix H. An electronic version of the F-75, the continuation sheet F-75c, and the instructions can be downloaded - <http://curator.jsc.nasa.gov/>.

3.4 Lunar Sample Inventory for Research samples

Annually, the Lunar Sample Curator will provide each PI with a complete inventory listing of samples in the investigator's possession for which the investigator is accountable. The PI is expected to review and verify the listing of current sample holdings to ensure (1) that all samples are appropriately listed, and (2) that all sample weights are correct. If the weight of a sample has changed as a result of destructive analysis, this fact must be documented and a F-75 submitted to change the accountable weight of the sample. The annual inventory must be supervised by the Principal Investigator and witnessed by a security official or other official of the investigator's institution. The verified inventory listing is to be promptly returned to the Lunar Sample Curator.

Where samples are in the possession of a Co-Investigator at the time of the annual inventory, the PI may authorize (in writing) the Co-Investigator to conduct the inventory and account for those samples in the possession of the Co-Investigator. That properly witnessed verification must be provided to the PI who will transmit it to the Lunar Sample Curator as part of the total inventory verification. In no case will the verification of sample inventory by any person other than a PI or an authorized Co-Investigator be accepted by the Lunar Sample Curator.

4.0 Sample allocations

Samples, including thin sections, are allocated to PIs on the recommendation of CAPTEM. Sample requests are reviewed by CAPTEM and approval is based on the premise that the PI is attempting to solve some specific lunar science or comparative planetology problem or an engineering study critical to future robotic or human missions. CAPTEM will usually respond directly to the PI requests, but on occasion may suggest alternative science strategies or samples based on its experience with lunar samples. The PI is not obligated to accept the recommendations in which case the PI and CAPTEM may need to negotiate a final allocation plan. Allocation plans are reviewed and approved by the Associate Administrator of the Science Mission Directorate at NASA Headquarters.

4.1 Sample Requests

It is essential that sample requests include a scientific discussion of the specific problem(s) that will be pursued in the sample studies and how the requested sample bear on the problem(s). Samples may be requested at any time. CAPTEM meets twice per year; one meeting is usually associated with the Lunar and Planetary Science Conference in March and the other usually occurs some time during October. Some requests will be evaluated between meetings. These requests include those from existing PIs requesting samples for previously approved projects, requests for thin sections only, requests for returned lunar samples. As a

general guideline, no lunar sample will be allocated that reduces the remaining pristine sample below 50% by weight. Exceptions are granted based on the importance of the scientific problems being studied.

4.1.1 Thin Sections

Thin section requests will be completed immediately to approved investigators with current Lunar Sample Loan Agreements, if the material is available. Requests for specific thin sections can be made, but general requests can be filled more promptly. If 1" round sections are required for the study that fact should be specified. A library of lunar thin sections is maintained and PIs can come to the Curation Facility to examine thin sections. Foreign visitors need to request access well in advance of their visit (2-3 months) to allow for badging security checks. We will request the necessary information once we receive the request. The PI can receive an immediate allocation of library thin sections for a period of 6 months. A long-term allocation of thin sections usually requires the fabrication of a new thin section.

Thin section studies are predicated on the assumption that the thin section will not be damaged in any way. Polished surfaces may be immersed in oil for microscopic observation, may be carbon coated for electron microprobe analysis, and may be gently cleaned and repolished in the course of these operations. Studies that require severe degradation of the surface such as ion microprobe or laser ablation inductively coupled plasma mass spectrometry analysis require permission of the Lunar Sample Curator.

4.1.2 Guidelines for Allocating Lunar Samples for Resource, Engineering, and Life Science Studies

Studies of resource utilization, engineering, and life science applications using lunar samples are encouraged. Lunar samples are, however, a scarce and precious national resource, and limited amounts of material are available for any type of study. Requests for samples must demonstrate knowledge of the lunar collection and be consistent with NASA policies concerning the heritage value of lunar samples.

All processes, procedures, and expected technical outcomes of the proposed tests must be described clearly in the sample request. The request must document the expertise of the team involved in the experiments. NASA funding for the proposed tests may be considered as evidence of expertise but is not a pre-requisite for receiving an allocation of lunar samples.

Prior tests using appropriate simulants are expected and must be documented. The request should identify specific properties of lunar material that make simulants unsuitable for the proposed tests. It is the responsibility of the requestor to obtain appropriate lunar simulants that have been characterized in the open literature, or provide to the Lunar Sample Curator all relevant and necessary information regarding physical or chemical properties of simulants prepared in-house.

The request must demonstrate efforts to downsize the scale of the tests for use of lunar material. Further, the proposers must verify that the request is for the minimum mass of lunar material that will yield useful results.

Test results on extraterrestrial materials are expected to be made available in the open scientific or technical literature. There is no propriety claim on data derived from tests on extraterrestrial materials allocated by NASA.

5.0 SAMPLE USE GUIDELINES

5.1 Numbering of Samples

Permanent numbers for samples are assigned by the Lunar Sample Curator's staff. Samples returned by investigators may be assigned new numbers when they are re-inventoried upon return to JSC. Investigators are required to identify all daughter samples by an unambiguous numbering system and account for them in their sample history. This numbering scheme must be explicitly written and available for inspection by NASA when security and inventory spot checks are conducted.

The Lunar Sample Curator's staff maintains sample records in a computer database. The computer programs accept the Lunar Sample Curator's numbering scheme, and no other. This numbering scheme is organized in such a manner that each individually separate sample is assigned a double number, the parts separated by a comma (e.g., 14026,34). The two parts are defined as the generic and specific numbers, (also parent, daughter) respectively.

The generic number has been assigned by the Lunar Curator. All samples from the same mission begin with an identical code, as shown in the following table.

<u>Mission</u>	<u>Number</u>
Apollo 11	10XXX
Apollo 12	12XXX
Apollo 14	14XXX
Apollo 15	15XXX
Apollo 16	6XXXX
Apollo 17	7XXXX
Luna 16	21XXX
Luna 20	22XXX
Luna 24	24XXX

Each generic number represents a single rock or soil sample. Some samples are homogeneous; others exhibit a high degree of variability.

On later missions (i.e., Apollo 15 and subsequent), numbering gives an indication of the type of sample represented, such as unsieved soil, sieve fractions, or rocks. Further, for these missions, sample numbers close to one another often indicate that the samples were collected at the same or adjacent lunar sites. These codes are explained fully in the lunar sample catalogs developed for each mission.

The specific number refers to an individual fraction of the whole, and numbers are assigned consecutively by the Lunar Curatorial staff as they are generated and entered in the Lunar Curatorial database.

5.2 Disposing of Samples Other Than by Return to Lunar Sample Curator

The process of analysis, or other operation involving lunar samples, may render them unrecognizable as lunar samples (note: loss of sample labels does not count as rendering samples as unrecognizable). The Lunar Sample Curator may authorize disposal other than by return. With respect to such a disposal, the PI is to inform the Lunar Curator of (a) the identity of the subject lunar sample(s) or lunar sample material(s), (b) the pertinent facts supporting the request for disposal rather than return, (c) a plan for the disposal of the subject material, and (d) submission of the requisite forms detailing the method of destruction, the sample number and type, and the mass involved.

The Lunar Sample Curator must approve all plans to destroy lunar samples in lieu of return to Curation Office. CAPTEM may be consulted for specific cases, if necessary.

5.2.1 Criteria for Samples that may be Destroyed in Lieu of Return to Lunar Curator

a. Sample destruction and disposal must take place by one of the accepted methods for destruction listed below.

b. In every case, destruction and disposal of the samples must be documented as described below.

5.2.2 Acceptable Methods for Lunar Sample Destruction

a. Dissolve the samples completely in acid.

b. Dilute the lunar material in and thoroughly mix with similar terrestrial material such that the lunar sample makes up <30% of the final, homogeneous mixture.

c. other methods may be approved after discussions between the PI and the Lunar Sample Curator (and CAPTEM if requested by the Lunar Sample Curator).

5.2.3 Documentation of Sample Destruction

The sample history form (F-75) will be used to document what samples are destroyed. Documentation must include:

a. The identity of the sample, including if it is a split of an originally allocated sample.

b. The weight of the sample that was destroyed (the split weight if appropriate, or the original weight if the entire sample has been destroyed).

c. The method of destruction.

d. The method of disposal.

5.2.4 Disposal of Containers, Trash, etc.

Disposable material of small value which comes in contact with lunar samples, such as containers, tools, paper, gloves, etc., should be treated as lunar material. Since lunar dust adheres to most surfaces, these items have potential collector item value. The PI should provide a disposal plan similar to that in section 5.2 or return all items to the Lunar Sample Curator for disposal. Under no circumstances are such items to be handled in a less secure manner than lunar samples themselves.

5.3 Acceptable Methods for Handling Extensively Subdivided Lunar Samples that do not Meet the Criteria for Destruction

Many lunar samples have been extensively subdivided, but do not meet the criteria for destruction discussed above. Nominally each split requires a separate sample history form (F-75). Completion of these largely duplicate forms is a large drain on PI and Curation resources. In some cases, this task may present an impediment to the return of samples. In most cases these samples are of limited value to other scientists. Whether there is value in the sample splits will be determined by consultation and discussion of the nature of the samples between the PI and the Lunar Sample Curator.

5.3.1 For Splits Determined Not to Have Significant Scientific Value

The splits can be recombined in a single vial and a gross weight determined. The gross weight of the recombined sample and the amount of sample lost to attrition can then be entered on the sample history form, F-75.

5.3.2 For Samples That Do Have Scientific Value

The splits will be returned as individually contained samples. A single F-75 will describe the process by which the samples were processed and any contamination information. An attachment should list weights of individual samples and describe further individual processing.

5.4 Sample Transfers

Samples that weigh 10 grams or less may be transferred by registered mail between locations in the United States. All samples weighing more than 10 grams are usually hand carried. Because of the ever changing conditions for air travel, exceptions to this requirement will be considered by the Lunar Sample Curator. Specific procedures follow for various cases encountered.

5.4.1 Transfers by Mail from the Lunar Sample Curator to Domestic Investigators

Samples transferred from the Lunar Sample Curator to a PI are addressed to “(PI name) RESTRICTED DELIVERY.” The RESTRICTED DELIVERY provision allows the PI to authorize someone else to pick up samples at the post office by depositing a letter of authorization at his local post office.

Registered mail will be held by a post office for ten days. If an investigator, who is expecting samples, will not be available to pick up mail for a longer period and has not designated an alternate to pick up RESTRICTED DELIVERY mail, the investigator should notify the Lunar Sample Curator so that samples will not be mailed.

5.4.2 Transfers by Courier from the Lunar Sample Curator to U.S. Investigators

If the aggregate sample weighs more than 10 grams, the Lunar Sample Curator will attempt to arrange courier service for the sample, but will generally contact the PI for assistance. A PI may request delivery of a sample to self or a designated courier at the Lunar Sample Curator's office at the JSC. A letter of authorization is required to identify a courier who is not a PI. The letter must contain the signature of both the PI and the courier. Because of the ever changing conditions for air travel, exceptions to this requirement will be considered by the Lunar Sample Curator. Specific procedures follow for various cases encountered.

If requested with adequate prior notification, the Lunar Sample Curator's staff will identify the package containing lunar samples for airline officials and will provide identifying documents for the courier's protection. It is recommended that PIs arrange for a similar letter from their own institution which will serve to identify a courier returning samples to JSC. Such a letter will prove valuable in expediting airport security check. An example of a letter provided by the Lunar Sample Curator is shown as Appendix I. Hand-carried samples must remain in the possession of the courier at all times. The courier's home institution should be advised of scheduled departure and arrival times and any changes or delays in order to prevent an overdue delivery going unnoticed. Most samples can be carried to the final destination in a few hours. In the event the courier must stop overnight, care must be taken to protect the samples. During an overnight stay, arrangements should be made to store the samples as safely as possible. Options include a hotel safe or at a local police station. It is recommended that a simple hand receipt be obtained if such storage is necessary. Every situation is different and the courier must use discretion to choose in their estimation the most prudent method of overnight storage. If such storage cannot be secured, the samples must be kept in courier's possession at all times. These caveats do not include lunar display, education, or education thin section samples.

5.4.3 Transfers from the Curation Office to Foreign Investigators

Samples for foreign investigators are shipped by an International Courier Service (e.g., FedEx) if the samples weigh 10 grams or less. On the inside package a label will be attached that indicates the foreign investigator's name and address. If the samples weigh more than 10 grams they will be hand carried as per domestic investigators, see above.

5.4.4 Transfers from Domestic and Foreign Investigators to the Curation Office

A PI should notify the Lunar Sample Curator by letter, phone, email, or FAX when a package of lunar samples has been sent for return to JSC. Samples are to be returned to the Lunar Sample Curator in containers that do not degrade the samples further than the experiments to which they have been subjected. Two layers of protection, such as a sample vial within a plastic bag, should be provided at a minimum. If requirements appear to be special, the Lunar Sample Curator should be contacted. The Lunar Sample Curator can also provide cleaned containers on request. One month should be allowed for delivery.

Packages containing no more than 10 grams of lunar materials may be mailed. They should be sent by REGISTERED MAIL "RETURN RECEIPT REQUESTED" to the following address:

REGISTERED MAIL
NASA Johnson Space Center
Attn: KT/Dr. Gary E. Lofgren
2101 NASA Parkway
Houston, Texas 77058

Samples returned by foreign investigators should be sent by international courier service (e.g., FedEx).

NASA Johnson Space Center
Attn: KT/Dr. Gary E. Lofgren
Bldg. 31, Room 248D
2101 NASA Parkway
Houston, Texas 77058
USA
281-483-6187

Packages containing more than 10 grams of lunar materials should not be mailed or sent by international courier service and must be hand carried, see 5.4 above.

The U.S. Government acts as a self-insurer, therefore investigators should not obtain postal insurance for lunar samples transmitted by U.S. mail service.

5.4.5 Transfer of Radioactive Materials

To transfer lunar samples to an irradiation facility in accordance with the provisions of section 5.4, the PI must obtain a security plan from the irradiation facility that describes the safeguarding of the samples upon arrival at the facility, storage prior to and after irradiation, and the procedures to be used for return of the samples to the PI. At a minimum, the plan must include all of the provisions of a *Lunar Sample Loan Agreement Security Plan* (Appendix A), and the following for shipment of the samples from the facility to the PI:

- a. Irradiated materials, packaged in accordance with the requirements of the Interstate Commerce Commission, will be sent from the irradiation facility to the PI via a commercial carrier who provides a means of controlling the movement of the container within and between terminals, whether by signature or armed guard service.
- b. The Bill of Lading will **not** identify the shipment as lunar samples.
- c. The PI will be notified of the expected time of arrival of each shipment.
- d. The Lunar Sample Curator will be notified immediately in the event a shipment is lost, and details of the loss will be confirmed in writing.
- e. The shipments will be subject to inspection by NASA on a spot-check basis.
- f. A written statement will be submitted to the Lunar Sample Curator by the responsible irradiation facility personnel, through the PI, that the procedures outlined in section 5.4 of this guidebook are being observed.

6.0 PROCESSING, PACKAGING, AND REMOTE STORAGE OF LUNAR SAMPLES

The conditions under which lunar samples are processed, stored, and packaged, as well as the capabilities of the Lunar Sample Curator's office to provide special samples to PIs, are described in the following paragraphs.

6.1 Lunar Sample Processing

6.1.1 Pristine Lunar Samples

Most lunar material is stored and processed in a dry nitrogen atmosphere in stainless steel glove boxes. The only materials allowed inside the cabinets, in the form of tools and containers, are stainless steel, aluminum, polyethylene vials, Teflon, and Viton A. The cabinets are equipped for binocular microscopy and photography to support descriptive studies.

Sub-samples are obtained by scooping or splitting samples of fines, and by chipping or sawing rocks. All of these operations are carried out within glove cabinets that contain dry nitrogen. No cooling agent is used in sawing operations. There are no facilities to sieve samples of fines other than the routine splits of <1mm, 1-2mm, 2-4mm, and 4-10mm. Samples can be shaped only with straight saw cuts; there is no capability of preparing circular disks. The success of rock sawing varies from rock to rock. Pieces as small as 1 mm thick can be cut from hard rocks, but it may be impossible to cut a slice thinner than 1 cm for incoherent/friable rocks. Requests for special sample configurations will be considered in association with review of sample requests. Contaminants from sawing are the materials of the blades: diamonds set in stainless steel for the band saws, and diamonds set in copper wire for the wire saws.

PI's are invited to examine rocks in nitrogen cabinets at the Lunar Curatorial Facility. Access to the collection must be requested in writing with justification, and is subject to scheduling by the Lunar Sample Curator. Foreign visitors need to request access well in advance of their visit (2-3 months) to allow for badging security checks. We will request the necessary information once the request is received. In general, technicians working in the Lunar Curatorial Facility will provide actual manipulation of the samples, and can support a variety of photographic requests. Requests to remove material from any sample must be approved in advance as described in Section 2.1.

6.1.2 Other Lunar Samples

A small quantity of sample material is stored in a helium atmosphere and has never been exposed to other gases since initial handling in the Lunar Sample Curatorial Facility. Two Apollo 16 and 17 core tubes are being maintained under vacuum in unopened condition.

Many samples returned by PIs, and a few other special samples, have been exposed to air and can be studied on laminar-flow clean benches. Requests for such inspections should be made in writing to the Lunar Sample Curator, with a statement of the scope, of the reasons for and the requirements of the proposed work. The Lunar Sample Curator will schedule visits to the facility as time and personnel allow. Special samples that fall into this category are coarse-fines (limited amounts of 1-2 mm fines that are available for the selection of specific types of material), and core tube peels (impregnated strips from core tubes, available for binocular microscope study).

6.2 Lunar Sample Packaging

Packaging of lunar samples is designed to provide the maximum protection of samples consistent with the amount of sample and the experiment to be performed. Samples are transmitted to investigators in containers of Teflon, aluminum, stainless steel, or polyethylene with protective layers that usually maintain the sample in nitrogen. Special packaging requirements can be designed to meet the requirements of lunar sample investigators as long as

those requirements do not call for materials other than stainless steel, Teflon, aluminum, polyethylene, or Viton to be introduced into the cabinets.

6.3 Remote Sample Storage

Approximately 14 percent by weight of the lunar sample collection is stored in a vault at White Sands Test Facility near Las Cruces, New Mexico. The collection includes representatives of each lithology recognized during preliminary examination, pieces from most of the large lunar rocks, sub-samples from many lunar soils, and an unopened core segment. Samples in remote storage are generally unavailable for scientific study (see also Section 7.3).

7.0 LUNAR CURATORIAL FACILITIES

7.1 Lunar Sample Curatorial Facility

The Lunar Sample Curatorial Facility and the Sample Information and Control Center are located in a specially designed building constructed to provide secure storage for the Apollo lunar sample collection and to protect the collection from contamination during storage and processing for transfer to laboratories for analysis. The building was designed to protect the lunar samples from theft, damage by natural hazards such as tornadoes and hurricanes, and contamination that would affect the interpretation of geochemical tests. Specially designed vaults with thick, reinforced concrete walls provide secure storage for the samples. The vault doors remain closed except for removal or storage of samples. All pipes and openings into the vaults close automatically if there is any disturbance in the building, such as fire or intrusion. Two vaults are used, one to store samples that have not been out of the sample laboratories and the other for samples that have been returned by investigators after analysis. In that way, "pristine" samples can never become mixed with "used" samples. The elevation of the vault floor is above the level of the highest expected storm surge at this location. All materials used in constructing the building (such as floor coverings, walls, plumbing, light fixtures, and paint) and equipping the laboratories were selected because they contain the lowest concentrations of critical elements such as lead, gold, and the rare earth elements.

Adjacent to the sample processing laboratory is a special experiment room for tests and measurements on particularly large or rare lunar specimens. Visiting scientists working with these specimens can take advantage of the facility's unique environmental controls, as well as the assistance of people experienced in the care of lunar materials.

A number of measures are taken to control airborne particles in the vaults and laboratories. The air is circulated through special filters to remove suspended particles and to maintain Class 10,000 or better conditions. The pressure of the filtered air in the lunar sample areas is kept slightly higher than the outside air pressure to keep unfiltered air from leaking into the laboratories. Persons entering the area wear nylon coveralls, shoe covers, caps, and gloves to reduce contamination by particles from clothing, shoes, hair, and skin.

Lunar samples are stored and processed in cabinets filled with positive pressure of dry nitrogen gas (<10 ppm water and oxygen) to prevent any reaction of the samples with the oxygen and water vapor in the Earth's atmosphere. An automatic monitoring system samples the gas in each cabinet once an hour to determine the oxygen and water content, and activates visual and audible alarms if either gas exceeds the preset limit.

Most of the samples sent to a PI's laboratory are exposed to the Earth's atmosphere during analysis. When returned, those samples are examined and packaged in filtered air on a flow bench. Other laboratory equipment includes balances, heat sealers, microscopes, fiber optic lighting systems, film and digital cameras, strobe lights, a band saw, and tools for subdividing the samples.

7.2 Custom Thin Section Laboratory

The Custom Lunar Thin Section Laboratory (CLTSL) was built to support the study of lunar samples through petrographic thin section research. In this laboratory, doubly polished thin sections are produced in accordance with the security and cleanliness rules and restrictions for lunar samples. The porous areas in samples are first filled with epoxy by vacuum or pressure impregnation. The samples are sawed to the right size and then attached with epoxy to glass microscope slides. CLTSL personnel use a combination of machine and hand polishing to produce sections with extremely flat, highly polished surfaces. High quality polishes are required for transmitted and reflected light microscopy at high magnification as well as for electron and ion microbeam analyses.

Most of the samples prepared in this laboratory are for distribution to scientists worldwide in the lunar sample science program. The CLTSL is not available for work outside the lunar sample program, because of the security requirements needed for sample control. Thin sections of lunar meteorites are made in our meteorite thin section lab.

7.3 Remote Lunar Sample Storage Facility

The Remote Lunar Sample Storage Facility, located at White Sands Test Facility (WSTF) near Las Cruces, New Mexico, is designed to protect a representative portion of the Apollo lunar sample collection from natural and man-made catastrophic incidents that might occur at JSC. As at JSC, this facility also provides for a secure and clean storage environment that is designed to protect the samples from terrestrial contamination.

Samples representative of the total Apollo lunar sample collection are stored in stainless steel leak-tight cabinets and maintained in a gaseous nitrogen environment to prevent degradation due to chemical changes and contamination by terrestrial sources. To maintain the effectiveness of this nitrogen blanket, the cabinets are purged with high-purity dry nitrogen approximately every six months. The vault and adjoining rooms are maintained in a high-level clean condition at all times.

7.4 Sample Information and Control Center

The Sample Information and Control Center (SICC) is the archive for all of the primary data associated with the curation of the Apollo lunar sample collection. The SICC is the shipping and receiving station for all lunar samples distributed by JSC. The center maintains current inventories of holdings and receives samples that are sent back from investigators. The SICC administers the lunar thin section education program and houses the thin section library for lunar samples. Many documents associated with the historical curation effort are archived in the SICC. Documents relevant to advanced planetary mission planning and general planetary science are also held in the SICC to support the work by scientists and planners in NASA.

8.0 LUNAR INFORMATION SOURCES

8.1 Lunar News

Lunar News is an electronic newsletter whose purpose is to provide a forum for facts and opinions about lunar sample studies, lunar geoscience, and the significance of the Moon in solar system exploration. *Lunar News* is published by the Office of the Lunar Curator and is sent via e-mail free to all interested individuals. To be included on the e-mailing list, direct a request to the Lunar Sample Curator (see section 2.1.2 for contact details).

8.2 Lunar Curatorial Databases

The Office of the Lunar Curator maintains an extensive database for tracking lunar samples as they are subdivided and allocated to scientists around the world. The database is currently not available via computer links as it once was because of computer security concerns. The database is currently being migrated to a new program that will eventually allow access through special servers placed outside the JSC firewall and not linked to the active database for security. The content available will be comparable to the current database.

8.3 Lunar and Planetary Institute

The Lunar and Planetary Institute (LPI) is a non-profit research institute operated by a consortium of U.S. and Canadian universities under contract with NASA, and is located near the JSC. In addition to conducting a research program, LPI operates a Visiting Scientist Program and maintains a comprehensive library of publications on lunar science and maps and photographs of the Moon. More details can be found at www.lpi.usra.edu.

8.4 Lunar Surface Information

The principal sources of information describing the local features of each Apollo landing site are contained in reports published by the U.S. Geological Survey and by NASA. Most are out of print, but copies can be examined in the SICC of the Office of the Lunar Curator, or at the LPI. Most of these documents are available on the Apollo Surface Journal web site:

<http://www.hq.nasa.gov/office/pao/History/alsj/frame.html>

8.5 Lunar Sample Information

8.5.1 Mission Catalogs

A lunar sample catalog containing sample descriptions has been published following each mission. The Apollo 11, 12, and 15 catalogs are out of print, but catalogs are available for Apollo 14, 16, and 17 from the Lunar Sample Curator. The catalogs are being published in electronic format. The catalogs for Apollo 11, 14, 15, and 16 will soon be available on the curation web site (<http://curator.jsc.nasa.gov>). The catalogs are also available at the Apollo Surface Journal web site; the images, however, are degraded by the copying process.

8.5.2 Special Sample Publications

Publications of special sample reports are provided to investigators by the Lunar Sample Curator. Such publications include descriptions of Apollo 12, 15, 16, and 17 4-10 mm coarse fines, Apollo 16 and 17 rake fragments, breccia samples from several missions, and descriptions of dissected cores.

8.5.3 Lunar Sample Photographs

A large collection of rock and thin section photographs are available for inspection in the SICC of the Office of the Lunar Curator. Photographs can be ordered from:

National Space Science Data Center
NASA Goddard Space Flight Center 1601.1
Greenbelt, Maryland 20771

8.5.4 Preliminary Examination Team Reports - Preliminary Science

A limited number of reprints of Preliminary Examination Team Reports from most Apollo missions is available from the Lunar Sample Curator. Preliminary Science Reports (90-day reports) for each mission containing descriptions of preliminary results from all Apollo experiments can be ordered from the Superintendent of Documents. The Preliminary Science Report incorporates the Preliminary Examination Team Reports. These reports are available on the Apollo Surface Journal web site.

8.5.5 Lunar Sample Compendium (draft edition available)

The data for a select group of lunar rocks (about 150) has been compiled in the Lunar Sample Compendium – available on line at:

<http://curator.jsc.nasa.gov/lunar/compendium.cfm>

8.5.6 Lunar List Server

(LUNAR-L@LISTSERV.ND.EDU)

This e-mail list server links lunar scientists, engineers, educators, and enthusiasts worldwide. For more information contact Clive R. Neal at neal.1@nd.edu or go to the LPI web site (www.lpi.usra.edu/captem).

Appendix A1

SAMPLE DOMESTIC TEMPLATE

LUNAR SAMPLE LOAN AGREEMENT

between

NASA Johnson Space Center

and

[INSTITUTION NAME]

[PRINCIPLE INVESTIGATOR NAME]

Principal Investigator

LUNAR SAMPLE LOAN AGREEMENT

The Johnson Space Center of the National Aeronautics and Space Administration, a Federal Agency, hereinafter referred to as JSC, desires to enter into a Loan Agreement and to make certain lunar materials available to the **[INSTITUTION NAME]**. **[INSTITUTION NAME]** proposes to use the said materials to undertake, at its own direction, scientific investigations in the area of **[SUBJECT]** as described in the approved scientific proposal.

The use of the lunar material will permit beneficial contact between representatives of JSC and **[INSTITUTION NAME]** will provide opportunities for discovery and dissemination of information about the Moon, the planets, and the solar system to the scientific community and to the general public; will promote the maximum utilization of lunar material by JSC; and will provide opportunities for dissemination of information concerning the activities of the National Aeronautics and Space Administration.

It therefore is agreed as follows:

1. The lunar samples made subject to this Agreement will be assigned to **[INSTITUTION NAME]** on Sample Assignment forms signed by the JSC Curator and the Principal Investigator of **[INSTITUTION NAME]** as designated in Attachment A.

2. The LUNAR SAMPLES are the property of the United States Government, are considered irreplaceable, and are therefore made available to users only under a carefully controlled and monitored program. It is therefore essential that rigorous security and accountability procedures be followed by all persons who have access to the LUNAR SAMPLES. As an integral part of this Agreement, **[INSTITUTION NAME]** will designate the Principal Investigator to be responsible for the receipt, use (including security during use), accountability and return of the LUNAR SAMPLES at the end of the designated time. **[INSTITUTION NAME]** agrees to strictly adhere to the procedures established in Attachment A for the security of the LUNAR SAMPLES.

3. **[INSTITUTION NAME]** shall be responsible for accurate accounting of all LUNAR SAMPLES by mass and location. **[INSTITUTION NAME]** shall perform an inventory of the LUNAR SAMPLES every year at the request of the JSC Lunar Sample Curator and send such inventory report to the JSC Curator. This inventory shall be witnessed by the Principal Investigator and by a security official or other official of **[INSTITUTION NAME]**. At the termination of this Agreement the LUNAR SAMPLES shall be returned to JSC with a full accounting of such LUNAR SAMPLES consistent with JSC 06090 "Handbook - Lunar Sample Program" (currently revision D).

4. **[INSTITUTION NAME]** agrees that the LUNAR SAMPLES may be used at **[INSTITUTION NAME]** or at other locations as agreed to in advance and in writing by the JSC Curator for the purposes stated above during the period as shown in paragraph 9. The use shall be solely for the purposes set forth in this Agreement. This Agreement **[DOES/DOES NOT]** allow **[INSTITUTION NAME]** to use destructive procedures.

5. When requested to do so during the period of the use, appropriate officials of **[INSTITUTION NAME]** shall provide to representatives of JSC three copies of any publication(s) resulting from the research and confer any scientific knowledge acquired as a result of such use, PROVIDED, HOWEVER, that no proprietary knowledge shall be disclosed involuntarily in the discharge of this obligation.

6. NOTWITHSTANDING any other provision of this Agreement, **[INSTITUTION NAME]** shall not be liable for loss of or damage to the LUNAR SAMPLES, or for expenses incidental to such loss or damage, except that **[INSTITUTION NAME]** shall be responsible for any such loss or damage (including expenses incidental thereto):

- a. which results from willful misconduct or lack of good faith on the part of the **[INSTITUTION NAME]** directors or officers, or on the part of any of the **[INSTITUTION NAME]** superintendents or any other equivalent

representatives, who have supervision or direction of all or substantially all of the [INSTITUTION NAME] business; or

b. which results from a failure on the part of [INSTITUTION NAME] due to the willful misconduct or lack of good faith on the part of any of his directors, officers, or other representatives mentioned in (a) above (i) to maintain and administer, in accordance with the provisions of this Agreement the program for delivery, protection, and preservation of Government property, or (ii) to take all reasonable steps to comply with any written directions from JSC with respect to the delivery, protection, and preservation of Government property.

HOWEVER, loss or damage to the LUNAR SAMPLES caused by failure to follow proper safeguarding standards as set forth in this Agreement will be considered in selecting participants in future agreements.

7. Title to the LUNAR SAMPLES shall remain with JSC and shall not be affected by the incorporation, attachment, or mixture thereof to or with property not owned by JSC.

8. [INSTITUTION NAME] shall be liable for all claims, demands, actions, costs, and charges made, asserted, or incurred by reason of any injury to any person or property, or loss of life or property, suffered or sustained during the period of the use and enjoyment when the injury, loss of life, or property damage is caused by any act or omission of any agent or employee of [INSTITUTION NAME].

9. This Agreement shall become effective upon the date of the last signature hereto and will remain in effect for [1 OR 3] years. This Agreement is subject to unilateral termination by either party upon 30-day's written notice. This Agreement may be terminated at any time upon written mutual agreement.

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10. This transaction to use personal property is entered into by JSC, in accordance with authority set forth in paragraph 203(c)(5) and (6) of the National Aeronautics and Space Act of 1958, as amended, and NHB 4200.1D dated April 1, 1992.

Lyndon B. Johnson Space Center
Lunar Sample Curator

Date

FROM: **[INSTITUTION NAME]**

Signature

Date

Title

ATTACHMENT A

[INSTITUTION NAME] Security Plan

ATTACHMENT A

PAGE 2

Details of security plan to be determined at the time the Loan Agreement is established.

I hereby designate **[PRINCIPAL INVESTIGATOR NAME]** to be the Principal Investigator of LUNAR SAMPLES, to assume the responsibility for the security of same, and their ultimate return to JSC.

Signature for
(INSTITUTION NAME)

Date

Title

Signature
[PRINCIPAL INVESTIGATOR NAME]
Principal Investigator

Date

Appendix A2

*****SAMPLE INTERNATIONAL TEMPLATE*****

INTERNATIONAL LUNAR SAMPLE LOAN AGREEMENT

between

NASA Johnson Space Center

and

[INSTITUTION NAME]

[PRINCIPLE INVESTIGATOR NAME]

Principal Investigator

INTERNATIONAL LUNAR SAMPLE LOAN AGREEMENT

The Johnson Space Center of the National Aeronautics and Space Administration, a Federal Agency, hereinafter referred to as JSC, desires to enter into a Loan Agreement and to make certain lunar materials available to the [INSTITUTION NAME], hereinafter referred to as [INSTITUTION NAME]. [INSTITUTION NAME] proposes to use the said material to undertake, at its own direction, scientific investigations in the area of [SUBJECT] as described in the approved scientific proposal. NASA and [INSTITUTION NAME] hereby designate U.S. Federal law to govern this Agreement for all purposes, including, but not limited to, determining the validity of the Agreement, the meaning of its provisions, and the rights, obligations and remedies of the Parties.

The use of the lunar material will permit beneficial contact between representatives of JSC and [INSTITUTION NAME]; will provide opportunities for discovery and dissemination of information about the Moon, the planets, and the solar system to the scientific community and to the general public; will promote the maximum utilization of lunar material by JSC; and will provide opportunities for dissemination of information concerning the activities of the National Aeronautics and Space Administration.

It therefore is agreed as follows:

1. The LUNAR SAMPLES made subject to this Agreement will be assigned to [INSTITUTION NAME] on Sample Assignment forms signed by the JSC Curator and the Principal Investigator of [INSTITUTION NAME] as designated in Attachment A.

2. The LUNAR SAMPLES are the property of the United States Government, are considered irreplaceable, and are therefore made available to users only under a carefully controlled and monitored program. It is therefore essential that rigorous security and accountability procedures be followed by all persons who have access to the LUNAR SAMPLES. As an integral part of this Agreement, [INSTITUTION NAME] will designate the Principal Investigator to be responsible for the receipt, use (including security during use), accountability, and return of the LUNAR SAMPLES at the end of the designated time. [INSTITUTION NAME] agrees to strictly adhere to the procedures established in Attachment A for the security of the LUNAR SAMPLES.

3. [INSTITUTION NAME] shall be responsible for accurate accounting of all LUNAR SAMPLES by mass and location. [INSTITUTION NAME] shall perform an inventory of the LUNAR SAMPLES every year at the request of the JSC Lunar Sample Curator and send such inventory report to the JSC Curator. This inventory shall be witnessed by the Principal Investigator and by a security official or other official of [INSTITUTION NAME].

At the termination of this Agreement the LUNAR SAMPLES shall be returned to JSC with a full accounting of such LUNAR SAMPLES consistent with JSC 06090 "Handbook - Lunar Sample Program" (currently revision D).

4. **[INSTITUTION NAME]** agrees that the LUNAR SAMPLES may be used at **[INSTITUTION NAME]** or at other locations as agreed to in advance and in writing by the JSC Curator for the purposes stated above during the period as shown in paragraph 9. The use shall be solely for the purposes set forth in this Agreement. This Agreement **[DOES/DOES NOT]** allow **[INSTITUTION NAME]** to use destructive procedures.

5. When requested to do so during the period of the use, appropriate officials of **[INSTITUTION NAME]** shall provide to representatives of JSC three copies of any publication(s) resulting from the research and confer any scientific knowledge acquired as a result of such use, PROVIDED, HOWEVER, that no proprietary knowledge shall be disclosed involuntarily in the discharge of this obligation.

6. NOTWITHSTANDING any other provision of this Agreement, **[INSTITUTION NAME]** shall not be liable for loss of or damage to the LUNAR SAMPLES, or for expenses incidental to such loss or damage, except that **[INSTITUTION NAME]** shall be responsible for any such loss or damage (including expenses incidental thereto):

- a. which results from willful misconduct or lack of good faith on the part of **[INSTITUTION NAME]** directors or officers, or on the part of any of its managers, superintendents or any other equivalent representatives, who have supervision or direction of all or substantially all of **[INSTITUTION NAME]** business; or
- b. which results from a failure on the part of **[INSTITUTION NAME]** due to the willful misconduct or lack of good faith on the part of any of its directors, officers, or other representatives mentioned in (a) above (i) to maintain and administer, in accordance with the provisions of this Agreement the program for delivery, protection, and preservation of Government property, or (ii) to take all reasonable steps to comply with any written directions from JSC with respect to the delivery, protection, and preservation of Government property.

HOWEVER, loss or damage to the LUNAR SAMPLES caused by failure to follow proper safeguarding standards as set forth in this Agreement will be considered in selecting participants in future agreements.

7. Title to the LUNAR SAMPLES shall remain with the JSC and shall not be affected by the incorporation, attachment, or mixture thereof to or with property not owned by the JSC.

8. To the extent permitted under the law of the country of **[INSTITUTION COUNTRY]**, **[INSTITUTION NAME]** shall be liable for all claims, demands, actions, costs, and charges made, asserted, or incurred by reason of any injury to any person or property, or loss of life or property, suffered or sustained during the period of the use and enjoyment when the injury, loss of life, or property damage is caused by any act or omission of any agent or employee of **[INSTITUTION NAME]**.

9. This Agreement shall become effective upon the date of the last signature hereto and will remain in effect for **[1 OR 2 YEARS]**. This Agreement is subject to unilateral termination by either party upon 30-day's written notice. This Agreement may be terminated at any time upon written mutual agreement.

10. This transaction to use personal property is entered into by JSC, in accordance with authority set forth in paragraph 203(c)(5) and (6) of the National Aeronautics and Space Act of 1958, as amended, and NHB 4200.1D dated April 1, 1992.

FOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Director, Exploration System and Aeronautics Division
Office of External Relations
NASA Headquarters
Washington, D.C.

Date

Lunar Sample Curator
Lyndon B. Johnson Space Center
Houston, Texas

Date

FOR: **[INSTITUTION NAME]**

Signature

Date

Title

ATTACHMENT A

[INSTITUTION NAME] Security Plan

a. The LUNAR SAMPLES shall be either hand-carried, at [INSTITUTION NAME] expense, by [INSTITUTION NAME] authorized official or mailed, at JSC's expense, to [INSTITUTION NAME] via diplomatic pouch. JSC reserves the right, at [INSTITUTION NAME] expense, to direct the mode of transportation for the return of the LUNAR SAMPLES.

b. Only the authorized official may receive and open the registered package. The authorized official shall record all of the LUNAR SAMPLES promptly upon receipt, and it shall be so identified so long as it remains in the custody, possession, or control of [INSTITUTION NAME].

Details of security plan to be determined at the time the Loan Agreement is established.

I hereby designate [PRINCIPAL INVESTIGATOR NAME] to be the Principal Investigator of LUNAR SAMPLES, to assume the responsibility for the security of same, and their ultimate return to JSC.

Signature for [INSTITUTION NAME] Date

Title

Signature
[PRINCIPAL INVESTIGATOR NAME]
Principal Investigator

Date

Appendix B

LUNAR PETROGRAPHIC THIN SECTION PACKAGE LOAN AGREEMENT

The Johnson Space Center of the National Aeronautics and Space Administration, a Federal Agency, hereinafter referred to as JSC, desires to enter into a Loan Agreement and to make certain material available to **[NAME OF INSTITUTION]**, hereinafter referred to as the INSTITUTION. The INSTITUTION proposes to use said material to undertake, at its own direction, scientific instructions in the area of lunar petrology.

The use of the material by the INSTITUTION will permit beneficial contact between representatives of JSC and the INSTITUTION; will promote a fuller awareness among young scientists of the importance of Government science, thereby enhancing the scientific recruitment possibilities for Government Agencies; will provide opportunities for dissemination of information concerning the activities of the National Aeronautics and Space Administration; and will promote maximum utilization of the material by JSC.

It therefore is agreed as follows:

1. The samples (hereinafter referred to as the PROPERTY) made subject to this agreement are: one Lunar Thin Section Set, containing 12 lunar sections, and one Educational Disk, containing 6 lunar samples.
2. The PROPERTY is the property of the United States Government, is considered irreplaceable, and is therefore made available to users only under a carefully controlled and monitored program. It is therefore essential that rigorous security and accountability procedures be followed by all persons who have access to the PROPERTY. As an integral part of this agreement, the INSTITUTION will designate one individual to be responsible for the receipt, use (including security during use), accountability, and return of the PROPERTY at the end of the designated time. The INSTITUTION will agree to strictly adhere to the following procedures for the security of the PROPERTY:
 - a. The PROPERTY shall be either hand-carried by the INSTITUTION's authorized official or mailed to the INSTITUTION via registered mail at JSC's expense. The JSC reserves the right at the INSTITUTION's expense, to direct the mode of transportation for the return of the PROPERTY.
 - b. Only the authorized official may receive and open the registered package. The authorized official shall record all of the PROPERTY promptly upon receipt, and it shall be so identified so long as it remains in the custody, possession, or control of the INSTITUTION.
 - c. During use for instructional purposes, the PROPERTY must be under the constant control of the authorized official. At no time may the PROPERTY be left unattended. At the end of each use of the PROPERTY, an inventory shall be made to insure the accountability of the PROPERTY. Such inventories shall be maintained as a permanent record and shall be made accessible to NASA at all reasonable times.
 - d. When not in use, the PROPERTY must be locked in a safe or secure storage cabinet equipped with a combination padlock.
 - e. Combination to the storage safe or cabinet will be under the exclusive control of the authorized official.
 - f. In no case may the PROPERTY be stored with money, precious stones or minerals, classified material, or any other item that is considered to be of high theft value.

- g. The INSTITUTION's security organization must be informed of the presence and location of the PROPERTY. During non-working hours, the security organization must periodically check the storage container.
 - h. To insure that appropriate security arrangements are followed, the INSTITUTION holding the PROPERTY shall be subject to inspection by NASA representatives at all times.
 - i. Report immediately the loss or damage of the PROPERTY to the Lunar Sample Curator, Johnson Space Center, Houston, Texas 77058, telephone (281) 483-3274.
3. The INSTITUTION agrees that the PROPERTY may be used only at **[NAME OF INSTITUTION]** for the purposes stated above during the period as shown in paragraph 8. The use shall be solely for the purposes set forth in this agreement.
4. When requested to do so during the period of the use, appropriate officials of the INSTITUTION shall confer with representatives of JSC, the scientific knowledge acquired as a result of such use, PROVIDED, HOWEVER, that no proprietary knowledge shall be disclosed involuntarily in the discharge of this obligation.
5. NOTWITHSTANDING any other provision of this agreement, the INSTITUTION shall not be liable for loss of or damage to the PROPERTY, or for the expenses incidental to such loss or damage, except that the INSTITUTION shall be responsible for any such loss or damage (including expenses incidental thereto):
- a. which results from willful misconduct or lack of good faith on the part of the INSTITUTION's directors or officers, or on the part of any of its managers, superintendents or any other equivalent representatives, who have supervision or direction of all or substantially all of the INSTITUTION's business; or
 - b. which results from a failure on the part of the INSTITUTION due to the willful misconduct or lack of good faith on the part of any of its directors, officers, or other representatives mentioned in (a) above (i) to maintain and administer, in accordance with the provisions of this agreement, the program for delivery, protection, and preservation of Government property, or (ii) to take all reasonable steps to comply with any written directions from JSC with respect to the delivery, protection, and preservation of Government property.
- HOWEVER, loss or damage to the PROPERTY caused by failure to follow proper safeguarding standards as set forth in this agreement will be considered in selecting participants in future agreements.
6. Title to the PROPERTY shall remain with JSC and shall not be affected by the incorporation, attachment, or mixture thereof to or with property not owned by JSC.
7. To the extent permitted under the law of the State of **[STATE]**, the INSTITUTION shall be liable for all claims, demands, actions, costs, and charges made, asserted, or incurred by reason of any injury to any person or property, or loss of life or property, suffered or sustained during the period of the use and enjoyment when the injury, loss of life, or property damage is caused by any act or omission of any agent or employee of the INSTITUTION.
8. This agreement shall become effective upon the date of the last signature hereto and will remain in effect for two months.
9. This transaction to use personal property is entered into by the Lunar Sample Curator of the Johnson Space Center, National Aeronautics and Space Administration, in accordance with authority set forth in paragraph 203(d)(5) and (6) of the National Aeronautics and Space Act of 1958, as amended, and NHB 4200.1A dated January, 1977.

FOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Education Sample Curator
Johnson Space Center

Date

FOR: [INSTITUTION]

Signature

Date

Title

I hereby designate [CUSTODIAN] to be the recipient of the samples, to assume the responsibility of same and their ultimate return to the Johnson Space Center, National Aeronautics and Space Administration.

Signature

Appendix C

LUNAR SAMPLE ASSIGNMENT

[Investigator Name] has been assigned the following sample(s):

GENERIC	SPECIFIC	PARENT	CONTAINER	WEIGHT GRAMS	NOTES
62255	87	51		0.10	

Lunar Sample Curator

Issue Date:
Request:

I acknowledge receipt of the above sample(s):

Signature & Date

Recipient's name, printed or typed

By accepting custody of the above sample(s), the recipient understands that it is furnished pursuant to, and is fully subject to, the terms and conditions of the grant or contract under which the related lunar sample analysis is to be performed, including all terms and conditions which may be incorporated in such contract or grant by reference.

**UPON RECEIPT OF THE SAMPLE(S), PLEASE SIGN THIS FORM
AND RETURN IT TO THE LUNAR SAMPLE CURATOR, MAIL
CODE KT, JOHNSON SPACE CENTER, HOUSTON, TX 77058.**

Appendix D

LUNAR PETROGRAPHIC THIN SECTION PACKAGE SAMPLE ASSIGNMENT

[Investigator Name] has been assigned a Lunar Petrographic Thin Section Package containing:

Lunar Thin Section Set Number 21 containing:

12002,395
14305,245
15299,174
60025,239
65015,156
68501,164
68501,169
68501,209
70017,212
70181,49
71061,32
74220,333

Lunar Educational Disk Number 112

Issue Date:

Lunar Sample Curator

I acknowledge receipt of the above sample(s):

Signature & Date

Recipient's name, printed or typed

By accepting custody of the above sample(s), the recipient understands that it is furnished pursuant to, and is fully subject to, the terms and conditions of the grant or contract under which the related lunar sample analysis is to be performed, including all terms and conditions which may be incorporated in such contract or grant by reference.

**UPON RECEIPT OF THE SAMPLE(S), PLEASE SIGN THIS FORM
AND RETURN IT TO THE EDUCATION SAMPLE CURATOR, MAIL
CODE KT, JOHNSON SPACE CENTER, HOUSTON, TX 77058.**

Appendix E

LUNAR SAMPLE RETURN RECEIPT

The Curator acknowledges receipt of materials identified by the following sample numbers:

FROM: [Investigator Name]

ON: [Date]

GENERIC	SPECIFIC
72435	59
72435	60
73155	29
73155	30
76055	73
76055	75
77115	55

These samples are being processed back into the active collection and will be cleared from your inventory.

Lunar Sample Curator

Appendix F

LUNAR PETROGRAPHIC THIN SECTION PACKAGE SAMPLE RECEIPT

The Curator acknowledges receipt of an educational package containing the following:

FROM: [Investigator Name]

ON: [Date]

Lunar Thin Section Set Number 6 containing:

12002,318

12005,36

14305,177

15299,148

60025,161

65015,124

68501,232

70017,5

70181,89

72275,509

74220,356

78235,99

Lunar Educational Disk Number 112

Your accountability for these items has been cleared.

Lunar Sample Curator

Appendix G: Examples of Curatorial Forms F-75 & 75c. Use forms downloaded from Curation Web Site: <http://curator.jsc.nasa.gov>**CURATORIAL FORM F-75****RETURN SAMPLE ACCOUNTABILITY & HISTORY**

PARENT SAMPLE _____, _____

PAGE _____ OF _____

Please complete one form for each sample on your inventory listing that you are returning. Use Form F-75, Continuation Sheets to document any subsamples that you have created from this sample. In the comments blocks, describe the history of contamination that each sample has experienced. Refer to the instructions for returning samples for more complete details.

A. INFORMATION PROVIDED BY SAMPLE INVESTIGATOR			
Item	Mass (g)	9. History/Contamination & PI Comments	
1. Mass of Sample as Issued by Sender _____ Name of Sender (If not Curator)			
2. Mass of Sample as Measured by You			
3. Total of Sample Mass Consumed			
4. Sample Mass Previously Returned to Curator			
5. Total Sample/Residue Mass Retained			
6. Sample Mass Transferred to Other PI's			
7. Total Sample Mass Returned to Curator			
8. Mass % of Admixed Material	%		_____ PI Signature
9. Sample Mass Not Accounted For			

B. FOR USE BY SAMPLE CURATOR ONLY			
PARENT SAMPLE PROCESSING			
Inventory Data		Item	Mass (g)
Sample #		Gross	
Container		Container	
Description		Dunnage	
Flags		Sample	
Location		Bagged	
Container Sample Returned In			
Sample Rebagged In		Air <input type="checkbox"/>	GN ₂ <input type="checkbox"/>
WEIGHT BALANCE ACCOUNTING			
Item		Mass (g)	
Issue			
Transferred to Other PI's			
Previously Returned			
Current Inventory			
Total Return (current)			
Retained by PI			
CONSUMED (Split #) _____			
CO Number			
Processor			
Date Processed			
_____ Curatorial Representative			
_____ Date			
PROCESSOR COMMENTS:			

JSC Form 1609 (Rev Jan 97)

CURATORIAL FORM F-75, Continuation Sheet
RETURN SAMPLE ACCOUNTABILITY & HISTORY

PARENT SAMPLE _____, _____

PAGE _____ OF _____

PLEASE COMPLETE ONE BLOCK FOR EACH SPLIT RETURNED			FOR USE BY SAMPLE CURATOR ONLY			
Split #	Mass (g)	History/Contamination & PI Comments	Rec.	Inventory	Item	Mass (g)
				Sample #		Gross
				Container		Container
				Description		Dunnage
				Flags		Sample
				Location		Bagged
				Sample #		Gross
				Container		Container
				Description		Dunnage
				Flags		Sample
				Location		Bagged
				Sample #		Gross
				Container		Container
				Description		Dunnage
				Flags		Sample
				Location		Bagged
				Sample #		Gross
				Container		Container
				Description		Dunnage
				Flags		Sample
				Location		Bagged
				Sample #		Gross
				Container		Container
				Description		Dunnage
				Flags		Sample
				Location		Bagged

SPLIT #	MASS	History/Contamination & PI Comments	Rec.	Inventory		Item	Mass (g)
				Sample #		Gross	
				Container		Container	
				Description		Dunnage	
				Flags		Sample	
				Location		Bagged	

JSC Form 1609A (Rev Jan 97)

Appendix H

INSTRUCTIONS FOR THE RETURN OF LUNAR PLANETARY SAMPLES TO NASA JOHNSON SPACE CENTER

1. ACCOUNTABILITY & HISTORY

1. Use Curatorial Form F-75. Complete one Curatorial Form F-75, Return Sample Accountability & History (Part A only) for the return of each sample which appears on your inventory listing. You do not need to complete the form to return samples which were issued to you as thin sections or probe mounts unless they were used in analysis by ion probe, proton probe, or other destructive technique.

Use Form F-75, Continuation Sheet to list any sub-samples that you have derived from the samples that you were assigned. If you have not made any splits, only the first page of the form need be used. If you have made more than 5 splits of any sample, you may either reproduce the Continuation Sheet yourself, or you may obtain additional copies from the Curator by contacting the Sample Control Center.

2. Use Official Sample Numbers According to Your Sample Inventory. You may obtain a current listing of your samples by contacting the Sample Control Center at 281-483-2254 or FAX 281-483-5347.
3. Document Sample Utilization According to Mass. Enter the appropriate mass for each item in the spaces provided in Part A, lines 1-8. The masses should refer to the entire sample which appears on your inventory listing. Note that the masses which appear on the inventory reflect the amounts for which you are currently accountable, and may differ from the original masses which you were issued. Such differences reflect transfers of portions of the samples which were authorized by the Lunar Sample Curator, any amounts consumed which you reported as the result of an annual inventory, or parts of the samples which you previously returned.
4. Document Sample History with Regard to Contamination or Modification. Document the contamination history for each sample in the spaces provided as block 9 of Part A. The following questions should be used as guidelines:
 1. Has the sample been chemically degraded by exposure to or admixture with major or trace elements, organic or inorganic liquids, or heavy metals?
 2. Has the sample been exposed to an electromagnetic field?
 3. Has the sample been separated based on mineralogical or petrological properties, grain size, density, or magnetic properties?

4. Has the sample been exposed to gases other than dry nitrogen, such as air, inert gases, or halogens?
5. Has the sample been heated, fused or dissolved, or otherwise undergone any thermodynamic change in state?
6. Has the sample been irradiated or undergone neutron activation?
7. Has the sample been affixed to or imbedded in a substrate such as glass or epoxy? Samples degraded in this manner will include thin sections, probe mounts, potted butts, grain mounts, etc. Please be specific as to the current state of the sample.
8. If the sample is a thin section or probe mount, has it been subjected to ion-probe analysis, proton-probe analysis, or other destructive method?

2. PACKAGING

1. Use Double Containers for Samples. As a minimum, provide two layers of protection against contamination, such as a sample vial within a plastic bag. Contact the Curator's office regarding special requirements; cleaned containers can be provided on request. Allow one month for delivery.
2. Package for U.S. Registered Mail or the Equivalent. Prepare packages so that they are strongly resistant to damage. Container strength and sealing provisions should be compatible with requirements of registered mail with the U.S. Postal Service.

3. TRANSMITTAL BY INVESTIGATORS IN THE UNITED STATES

1. Hand-Carry Large Samples. Samples that weigh more than 10 grams, individually or in total, must be hand-carried to the Sample Curator unless the Curator provides a written exemption in advance.
2. Send Small Samples by Registered Mail. Samples weighing less than 10 grams may be mailed from points within the U.S. You may request NASA official business return mailing labels from the Curator's Office; you must add your name clearly to the labels. (In the event that the Post Office will not accept these labels, you are required to pay the postage.) Send the samples by REGISTERED MAIL, RETURN RECEIPT REQUESTED to the following addresses:

For Lunar Samples send to:

Dr. Gary E. Lofgren
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Mail Code KT
2101 NASA Parkway
Houston, Texas 77058-3696 USA

The U.S. Government acts as a self-insurer. Do not obtain postal insurance for planetary materials samples transmitted by the U.S. Postal Service.

4. TRANSMITTAL BY INVESTIGATORS OUTSIDE THE UNITED STATES

1. Hand-Carry Large Samples. Samples that weigh more than 10 grams, individually or in total, must be hand-carried to the Lunar Sample Curator unless the Curator provides a written exemption in advance.
2. Use International Courier Service, e.g. FedEx to return sample to the Lunar Sample Curator that weigh less than 10 grams singly or in the aggregate. Samples packaged separately can be placed in different packages to keep the weight under 10 grams. Address package to:

Dr. Gary E. Lofgren
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Mail Code KT
2101 NASA Parkway
Houston, Texas 77058-3696 USA
Telephone: 281-483-6187
FAX: 281-483-5347

5. INFORMATION

If you require help in any aspect of your sample return, please use one of the following points of contact:

Telephone: 281-483-3274

FAX: 281-483-5347

E-mail: gary.e.lofgren@nasa.gov

Appendix I

EXAMPLE OF COURIER LETTER

[DATE]

KT-[NUMBER]

TO: Airline Officials, U. S. Customs, and Law Enforcement Personnel

FROM: KT/Astromaterials Acquisition and Curation Office

SUBJECT: Transport of Lunar Samples by Courier

This letter, when accompanied by positive personal identification, will identify **[NAME OF COURIER]** of the **[INSTITUTION]**, **[CITY, STATE OR COUNTRY]**, as a courier of Lunar Samples that are the property of the National Aeronautics and Space Administration (NASA), an Agency of the Federal Government of the United States of America. The courier is transporting rock samples from Johnson Space Center, Houston, Texas to **[INSTITUTION]**, **[CITY, STATE OR COUNTRY]** on **[DATE]**. The samples consist of small amounts of lunar soil or rocks contained in plastic vials or bags, aluminum or stainless steel containers. The samples may have the following numbers:

10057,40	119.100g
10084,18	100.180g
12001,114	100.000g

These samples are considered invaluable, irreplaceable national treasures; therefore, it is requested that the courier be permitted to hand-carry the above-described material to his destination at the **[INSTITUTION]**. The courier has been instructed to keep the materials in his personal custody at all times.

If additional verification is required, please contact a representative of the NASA Lyndon B. Johnson Space Center at one of the telephone numbers listed.

Normal Duty Hours: 8:00 a.m. - 5:00 p.m., Central Standard Time, Monday - Friday:
Gary E. Lofgren, Lunar Sample Curator 281-483-6187
Carlton C. Allen, Manager 281-483-5126 / 5033
Astromaterials Acquisition and Curation Office

Night/Other Hours Contact:
Gary Lofgren 281-648-7519
Carlton Allen 281-992-3772

Your cooperation in expediting the courier's boarding of the aircraft and protecting the integrity of this material will be greatly appreciated.

Gary E. Lofgren
Lunar Sample Curator
Astromaterials Acquisition and Curation Office